Savannah River Site
Dose Reconstruction NEWS
Phase II: Source Term Calculation and Environmental Pathway Data Retrieval

Volume II, Number 3 **July 1997**

Estimating the Atmospheric Tritium Source Term at SRS: A Progress Report

To date, historical records searches have revealed that the main sources of tritium releases from early Savannah River Site (SRS) operations were the reactor areas (100 Areas) and the chemical separations and tritium packaging areas (F & H Areas). Most of the tritium released from the reactors to air was in the form of tritiated water or water vapor from the evaporation of the moderator. (The moderator used in SRS reactors was heavy water [deuterium oxide]. The moderator slowed the fission neutrons, allowing a chain reaction to occur in the reactor core.)

In the separations and tritium packaging areas, most of the tritium was released in the form of elemental hydrogen gas, rather than as tritiated water. Because it moves through living cells in the same manner as water, tritiated water is more hazardous biologically than tritium gas.

In many cases, the equipment that was used at SRS to monitor tritium was developed or designed onsite. This was necessary because off-the-shelf, production-level tritium measuring equipment was not yet available. Because the SRS was one of the first sites involved in tritium work, SRS scientists and engineers were at the forefront during development of tritium measurement technology. Glimpses of the instrument development process can be seen in SRS memos describing possible new technologies, and in letters received from other sites and facilities requesting advice from the SRS staff.

Atmospheric release: Radionuclides or chemicals released through stacks, vents or by other means to the outside atmosphere.

Moderator: A component (usually water, heavy water, or graphite) used in nuclear reactors to slow neutrons, making them more effective in producing fission events within the core, enabling a continuing or "chain" reaction to take place.

Source term: The quantity of a radioactive material or chemical released from sources or incidents at a facility. It is usually specified as a rate (quantity released over time, such as Becquerels per second).

Equipment

The atmospheric tritium monitoring equipment used at SRS in the 1950s and 60s included dehumidifiers, silica gel samplers (in the reactor areas), and Kanne ionization chambers (in the reactor areas and the separations and tritium facilities). During the early 1970s, further developments introduced the reactor area Stack Tritium Monitor, and the Stack Monitor Integrator to automate the Kanne chamber measurements in the F & H area.

Because different instruments are better at detecting tritium in its different forms, over the years several methods were used to measure tritium releases at SRS. In the late 1950s, reactor moderator tritium losses were derived from the moderator inventory assessment, and stack releases were determined by analyzing water samples condensed from the stack stream by a dehumidifier. These methods provided a measurement of total tritium release, but they did not determine release rates or

the periods of specific, higher releases. The dehumidifier method was considered to be of most value only during continuous routine operations.

The Kanne ionization chambers were also used to monitor stack exhausts for tritium. A probe in a reactor stack carried a sample of effluent to a Kanne chamber. Release values were recorded on a paper chart and an alarm was set to sound at a predetermined concentration. This method was used in the separations and tritium facilities to attempt to measure the release of tritium gas. However, the Kanne chambers also were sensitive to noble gas activity present in the reactor stack effluent.

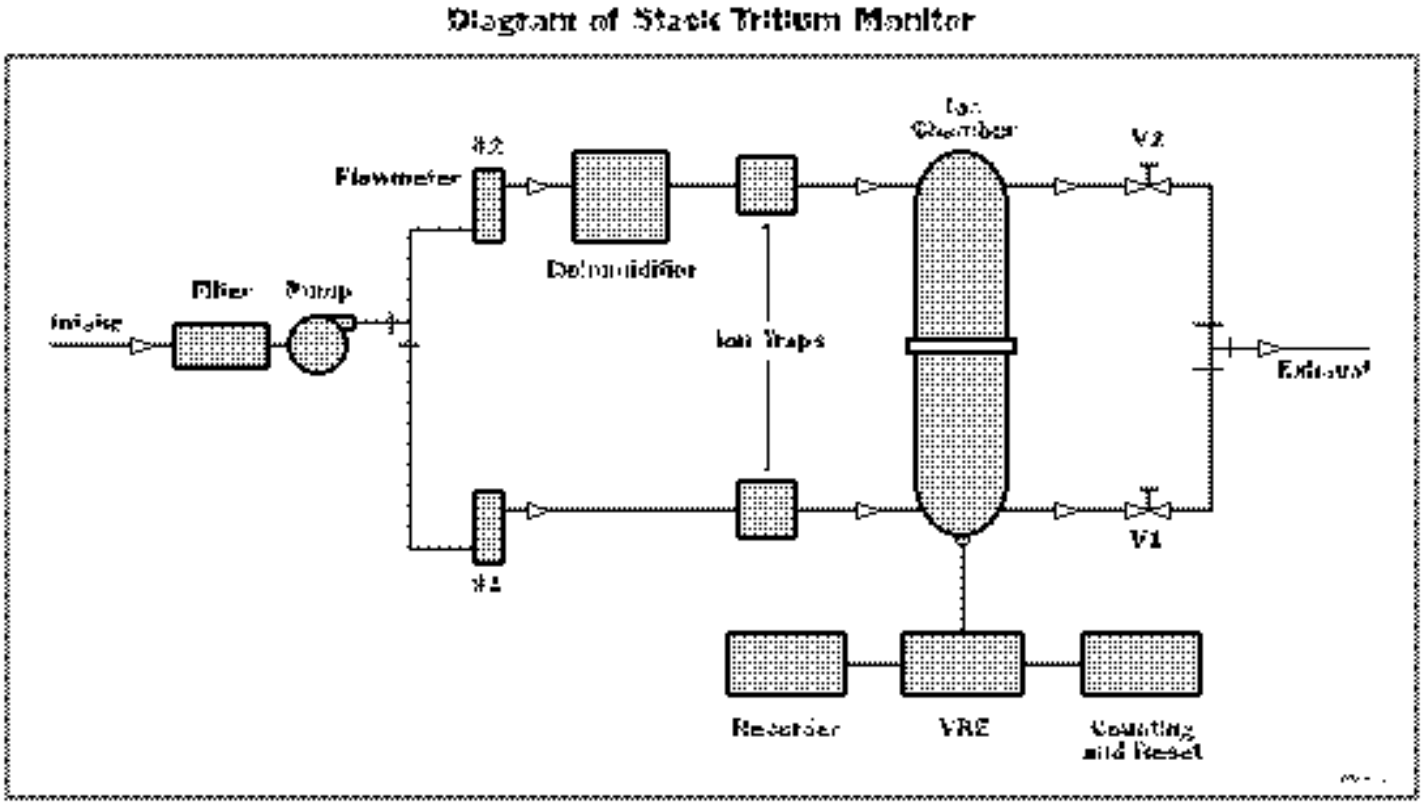

Figure 1 – Diagram of the first Stack Tritium Monitoring system used at SRS in the early 1960s.

In the early 1960s a Stack Tritium Monitoring system was built that could measure the rate of tritium release and could also differentiate between tritium and other radioactive gases. This new method allowed for measuring tritium online in the presence of noble gases. The reactor stack gas sample was split in two: one-half of the gas went directly to a Kanne chamber, and one-half passed through a cold trap to remove the tritiated water vapor before flowing to another identical Kanne chamber (see Figure 1, above). The difference in activity between the two chambers was equal to the tritiated water activity removed from the air.

In the late 1960s, the Stack Tritium Monitor was improved and a Stack Monitor Integrator was installed in the Separations Building (232-F). Instead of requiring an operator to manually total stack releases recorded on chart paper, the computerized Stack Monitor Integrator totaled releases hourly. The system sent an alarm signal and integrated the releases minute-by-minute in high concentration (accident) conditions.

Preliminary Atmospheric Tritium Source Term for 1955–1964

Several SRS report series (the Works Technical, Health Physics, and Environmental reports) that document past atmospheric tritium releases have been located and reviewed. These documents include daily worker logbook entries and reports concerning the monthly releases from the reactors and Buildings 232-H and 234-H. The monthly releases have been reconstructed whenever possible. In general, the release values reported in the different sources are consistent. Figure 2 presents annual atmospheric tritium releases from SRS, and from the reactors and the F & H areas for the periods that have been determined to date. Between 1955 and 1964, the tritium releases ranged to 2.4 million curies per year. For each year, approximately 60 to 95% of the annual SRS tritium releases were from the F & H areas. Releases changed with time, due to increased reactor power, higher tritium production and changes in tritium activity in the reactor moderator.

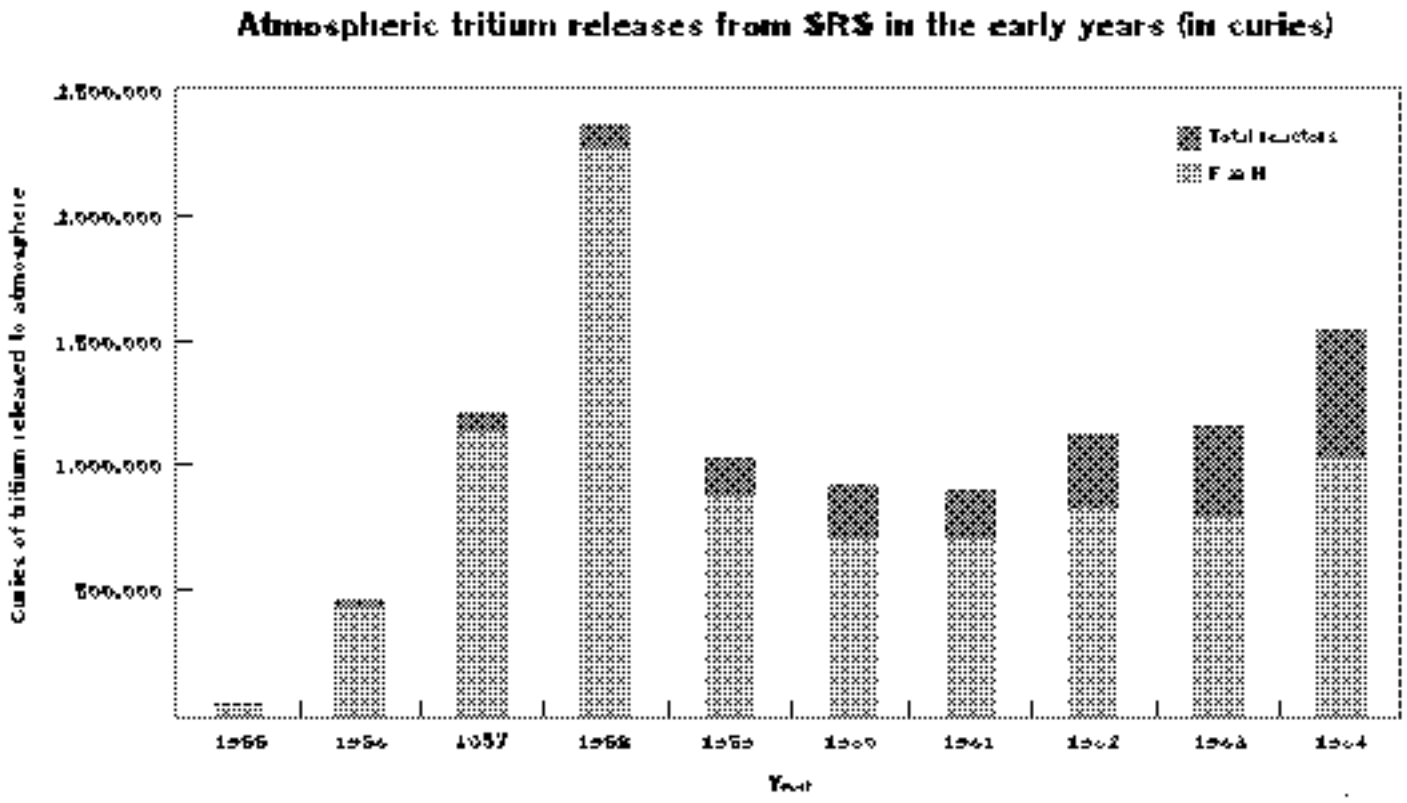

Figure 2 - Atmospheric tritium releases from SRS in the early years 1955-1964 (in Curies). (These data are preliminary, and have not yet been evaluated for accuracy and uncertainty.)

Measurement Uncertainties

Before the data shown in Figure 2 are published in a final report, they must be evaluated for accuracy and uncertainty. The factors to be considered are the times of operation of each type of monitoring equipment at each facility; the calibration and maintenance of the equipment; the environmental conditions that could have affected the quality of the measurements (including humidity and temperature); the form of tritium released from each of the facilities; and the measurement of related data (including activity in the moderator and stack air flow rates). Estimates of these factors will be included in the uncertainty analysis of the final source term estimates.

An Open, Public Process

Public involvement is critical to this project. We encourage your input and attendance at public meetings, to stay informed concerning the research. Public meetings are held in areas near SRS and will be announced in Project newsletters.

The Centers for Disease Control and Prevention, Radiological Assessments Corporation, and South Carolina State University scientists wish to provide clear and accessible information. Newsletters and fact sheets are published regularly to provide updates on the research. Detailed technical information, including copies of the electronic database describing information discovered through the end of the Project's first Phase, is available upon request.

Addresses for inquires and comments are located below. Individuals with information or questions related to the study are encouraged to call the Project's toll-free number, 800-637-4766.

Radiological Assessments Corporation
417 Till Road
Neeses, SC 29107

If you have information or inquiries related to the study, please contact:

Dr. John E. Till
Radiological Assessments Corporation
417 Till Road
Neeses, SC 29107
Phone: 800-637-4766 or Fax: 803-534-1995

or,

Mr. Paul Renard
Centers for Disease Control and Prevention
4770 Buford Highway, NE (MS F35)
Atlanta, GA 30341-3724
Phone: 770-488-7040 or Fax: 770-488-7044